

Claims

- [c1] A medical device for navigation through anatomy, the medical device comprising:
 - an elongate body having a proximal end, a distal end, and a longitudinal axis extending at least from the proximal end to the distal end; and
 - a helical first coil formed from wire having a substantially non-circular cross section; and
 - said cross section having a greater dimension in the radial direction than in the axial direction.
- [c2] The medical device of claim 1, said body comprising a tubular member having a plurality of slots configured to make said tubular member more flexible in bending.
- [c3] The medical device of claim 1, said first coil being located at or near said distal end, said first coil substantially comprising a substantially radiopaque material.
- [c4] The medical device of claim 3, said body comprising a tubular member having a plurality of slots configured to make said tubular member more flexible in bending, said body further comprising a core wire, at least part of said core wire being located inside said tubular member,

at least a portion of said core wire being located inside said first coil.

[c5] The medical device of claim 1 further comprising a second coil sharing said longitudinal axis with at least said body.

[c6] The medical device of claim 1, said medical device being a guidewire.

[c7] A medical device configured to be guided to a target location in anatomy, the medical device comprising:
a first tubular member having a proximal end and a distal end;
a core wire extending proximally from said first tubular member, said core wire being attached with a joint to said first tubular member at least at said proximal end, said joint comprising:
a first coil circumscribing said core wire, said first coil being at least partially inside said first tubular member, and
at least one of solder and adhesive.

[c8] The medical device of claim 7, said core wire being metal and said first coil being metal, said joint comprising solder attaching said first coil to said core wire and adhesive attaching at least one of said first coil, said core

wire, and said solder, to said first tubular member.

[c9] The medical device of claim 7, said first tubular member having superelastic properties and at least part of said distal end being heat treated to reduce said superelastic properties at said distal end.

[c10] The medical device of claim 7 said first tubular member comprising a plurality of slots formed in said first tubular member, at least a plurality of said slots being substantially perpendicular to said axis, said slots being formed in a plurality of groups, and at least a plurality of said groups comprising a plurality of slots at substantially the same location along said axis.

[c11] The medical device of claim 10, wherein in at least some said groups, at least one said slot is substantially deeper than at least one other said slot.

[c12] The medical device of claim 7 further comprising a second tubular member circumscribing at least a portion of said core wire.

[c13] The medical device of claim 7, said first coil being formed from wire having a wire diameter, said first coil having at least a portion of its length with a pitch of at least 1.5 times said wire diameter.

- [c14] The medical device of claim 7, said core wire having a tapered portion, said joint being located at least partially within said tapered portion.
- [c15] The medical device of claim 7 further comprising a second coil having a larger outside coil diameter than said first coil.
- [c16] The medical device of claim 7, said core wire having a feature configured to facilitate mechanical interlock of said at least one of solder and adhesive, said joint being located at said feature.
- [c17] The medical device of claim 16, said feature comprising at least one of a step and a ridge.
- [c18] The medical device of claim 7, said first tubular member having a chamfer at said proximal end.
- [c19] The medical device of claim 7, said core wire further being attached to said first tubular member at said distal end of said first tubular member.
- [c20] The medical device of claim 7, said core wire further being attached to said first tubular member at least one location intermediate said proximal end and said distal end.
- [c21] The medical device of claim 7, said core wire having a

proximal section proximal to said first tubular member, said proximal section having a first outside diameter along at least a majority of its length, and said first tubular member having a second outside diameter along at least a majority of its length, said first outside diameter being larger than said second outside diameter.

[c22] A medical device configured to be guided to a target location in anatomy, the medical device comprising:
a tubular member having a proximal end and a distal end and a plurality of slots configured to make said tubular member more flexible in bending; and
a core wire having a proximal section extending proximally from said tubular member, and a distal section located inside said tubular member, said core wire being attached to said tubular member at least at said proximal end; and
at least part of said proximal section having a substantially round cross section and at least part of said distal section having a flattened cross section.

[c23] The medical device of claim 22 further comprising substantially radiopaque material located inside said tubular member at said distal end.

[c24] The medical device of claim 23 said substantially radiopaque material having a substantially semicircular

cross section and being located on opposite sides of said flattened cross section of said distal section of said core wire.

[c25] A medical device with a stepped core wire configured to be guided to a target location in anatomy, the medical device comprising:

a tubular member having a proximal end and a distal end and a plurality of slots configured to make said tubular member more flexible in bending; and

a core wire having a proximal section extending proximally from said tubular member, and a distal section located at least partially inside said tubular member, said core wire comprising an abrupt change in cross-sectional dimension between said proximal section and said distal section; and

said core wire being attached to said tubular member at least at said proximal end, said proximal end abutting said abrupt change in cross-sectional dimension.

[c26] The medical device of claim 25 further comprising a coil circumscribing at least a portion of said core wire.

[c27] The medical device of claim 26, said coil being soldered to said core wire, said tubular member being attached at least to said coil with adhesive.

[c28] A medical device configured to be guided to a target location in anatomy, the medical device comprising:
a first tubular member having a proximal end and a distal end, and a longitudinal axis extending at least from the proximal end to the distal end;
a plurality of slots formed into said first tubular member and configured to make said first tubular member more flexible in bending;
a core wire extending proximally from said proximal end of said first tubular member; and
a first coil extending distally from said distal end of said first tubular member.

[c29] The medical device of claim 28 further comprising a second tubular member sharing said longitudinal axis.

[c30] The medical device of claim 29, said second tubular member extending distally from said distal end of said first tubular member, said second tubular member being at least partially located inside said first coil.

[c31] The medical device of claim 29, said second tubular member comprising a plurality of slots configured to make said second tubular member more flexible in bending.

[c32] The medical device of claim 28, said first tubular mem-

ber comprising a first portion without said slots and a second portion with said slots, said first portion being proximal to said second portion.

[c33] The medical device of claim 28, said core wire being attached with a joint to said first tubular member at least at said proximal end of said first tubular member, said joint comprising a second coil circumscribing said core wire, and said second coil being at least partially inside said first tubular member; and said joint further comprising at least one of solder and an adhesive attaching said second coil to said core wire and said first tubular member at least to said second coil.

[c34] The medical device of claim 33, said core wire comprising an abrupt change in cross-sectional dimension at said joint.

[c35] The medical device of claim 28, said slots being arranged in groups of three.

[c36] The medical device of claim 28, said first tubular member having a chamfer at said proximal end.

[c37] The medical device of claim 28, said core wire having a distal tip, said distal tip being at least partially flattened.

[c38] A slotted medical device configured to navigate through

anatomy, the medical device comprising:

a first tubular member having a proximal end, a distal end, and a longitudinal axis extending at least from the proximal end to the distal end;

a plurality of groups of slots formed into said first tubular member, at least a plurality of said groups comprising a plurality of slots at substantially the same location along said axis;

at least a plurality of said longitudinally adjacent said groups being substantially equal size and each being rotated about an angle around said axis from the previous said group;

at least a plurality of said groups having in the axial direction at least three slots.

[c39] The medical device of claim 38, each said slot in at least a plurality of said groups being substantially equal spaced around said axis.

[c40] The medical device of claim 38, the spacing between said groups varying gradually along at least part of said first tubular member providing a varying bending stiffness along at least part of said first tubular member, said groups being more closely spaced at said distal end.

[c41] The medical device of claim 38, at least a plurality of said longitudinally adjacent said groups being rotated at

an angle around said axis from the previous said group, said angle being 180 degrees divided by the number of slots in the group, plus or minus no more than 10 degrees.

[c42] The medical device of claim 38, at least a plurality of said groups consisting of three slots.

[c43] The medical device of claim 38 further comprising a core wire disposed within said first tubular member and extending proximal therefrom, the medical device being a guidewire.

[c44] The medical device of claim 43, said core wire being attached with a joint to said first tubular member at least at said proximal end of said first tubular member, said joint comprising a metal first coil soldered to said core wire, said first coil circumscribing said core wire, and said first coil being at least partially inside said first tubular member; and said joint further comprising an adhesive attaching at least said first coil to said first tubular member.

[c45] The medical device of claim 43, said first tubular member extending distal to said distal tip of said core wire, said medical device further comprising at least one piece of radiopaque material inside said first tubular member

and distal to said distal tip of said core wire.

[c46] The medical device of claim 43 further comprising a coil extending distal to said first tubular member, said core wire extending distal to said first tubular member inside said coil.

[c47] The medical device of claim 46, said core wire being axially but not torsionally constrained relative to said coil at said distal tip of said core wire.

[c48] The medical device of claim 38, said first tubular member having superelastic properties.

[c49] The medical device of claim 48, said first tubular member having a tip, said tip having reduced superelastic properties.

[c50] The medical device of claim 38 further comprising a second tubular member attached to said medical device.

[c51] The medical device of claim 50 said second tubular member comprising a plurality of slots configured to make said second tubular member more flexible in bending.

[c52] The medical device of claim 38, said first tubular member having chamfer at said proximal end.

[c53] A medical device configured to navigate through anatomy, the medical device comprising:
a tubular member having a proximal end, a distal end, and a longitudinal axis extending at least from the proximal end to the distal end, the tubular member comprising a plurality of slots configured to make it more flexible in bending;
a core wire disposed at least partially within said tubular member and extending proximal therefrom, said core wire having a distal tip;
a joint attaching said core wire to said tubular member at said proximal end of said tubular member; and
at least one piece of radiopaque material inside said tubular member, at or adjacent to said distal end of said tubular member.

[c54] The medical device of claim 53, at least a plurality of said slots being substantially perpendicular to said axis, said slots being formed in a plurality of groups, at least a plurality of said groups comprising a plurality of slots at substantially the same location along said axis, and wherein in at least some said groups, at least one said slot is substantially deeper than at least one other said slot.

[c55] The medical device of claim 53, said radiopaque material being a helical coil made of wire having a substantially

non-circular cross section, said wire having a substantially greater dimension in the radial direction than in the axial direction after being formed into said coil.

- [c56] The medical device of claim 53 further comprising a mesial coil proximal to said radiopaque material.
- [c57] The medical device of claim 53, said tubular member extending distally from said distal tip of said core wire, said radiopaque material being distal to said distal tip of said core wire.
- [c58] The medical device of claim 53, said core wire further being attached to said tubular member at said distal tip of said core wire.
- [c59] The medical device of claim 53, said core wire having at least one abrupt change in cross-sectional dimension, said abrupt change being at or adjacent to said joint.
- [c60] A medical device configured to navigate through anatomy, the medical device comprising:
 - a first tubular member having a proximal end, a distal end, and a longitudinal axis extending at least from the proximal end to the distal end, the first tubular member comprising a plurality of slots configured to make it more flexible in bending;
 - a second tubular member sharing said longitudinal axis

with said first tubular member; and
a core wire sharing said longitudinal axis with said first tubular member and said second tubular member;
said first tubular member being attached to at least one of said second tubular member and said core wire; and
said second tubular member being attached to at least one of said first tubular member and said core wire.

[c61] The medical device of claim 60, said second tubular member being concentric with said first tubular member.

[c62] The medical device of claim 60, said second tubular member being in line with said first tubular member.

[c63] The medical device of claim 60, said second tubular member comprising a plurality of slots configured to make it more flexible in bending.

[c64] The medical device of claim 60 further comprising a first coil concentric with at least one of said first tubular member, said second tubular member, and said core wire.

[c65] The medical device of claim 64, said first coil being inside at least one of said first tubular member and said second tubular member.

[c66] The medical device of claim 64 further comprising a sec-

ond coil circumscribing at least said core wire.

[c67] The medical device of claim 60, said medical device being configured such that tensioning said core wire causes said distal end of said first tubular member to change in shape.

[c68] The medical device of claim 67, at least some of said slots being deeper on one side of said axis than on the other side of said axis to facilitate said change in shape.

[c69] A tapered medical device configured to navigate through anatomy, the medical device comprising:
a tubular member having a proximal end, a distal end, and a longitudinal axis extending at least from the proximal end to the distal end, at least a portion of said tubular member comprising a plurality of slots, said slots being configured to make said tubular member more flexible in bending;
a core wire disposed within said tubular member and extending proximal therefrom;
said core wire being attached to said tubular member at least at said proximal end of said tubular member;
said tubular member having a taper at least in its outside diameter over at least a portion of its length, said taper having a decreasing outside diameter in the distal direction, said taper being at least one of continuous and in-

cremental.

- [c70] The medical device of claim 69, said tubular member having a continuously tapered outside diameter over at least a portion of said tubular member.
- [c71] The medical device of claim 69, said tubular member having an outside diameter that changes in at least one step between said proximal end and said distal end of said tubular member.
- [c72] The medical device of claim 69, said tubular member comprising a plurality of sections having different outside diameters, the sections being attached to each other to form said tubular member.